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9 Game On

Using Virtual Reality to Explore the User-Experience in Sports Media

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On March 5th, 1733, a written article detailing a prizefight in England was published in the *Boston Gazette*, and became one of the earliest examples of sports media. It was imported from Europe, heavily delayed in its' distribution to the well-educated and wealthy colonials in North America (Bryant and Holt 2006). For the next one hundred years, media coverage of sports would remain a pastime reserved solely for the wealthy until newspapers began targeting urban, middle-class audiences. Given the much more inclusive modern landscape of television, writing and radio, it is difficult to conceptualize how early sports media could have ever been so delayed or restricted to such small audiences. However, the history of sports media is a history of innovation to reach new audiences (Bryant and Holt 2006).

Sports media coverage most notably began with newspaper columns by sports journalists in the 1830s (Bryant and Holt 2006), which specifically started to cover

sports like horse racing. With the invention of radio technology, fans began listening to sporting events as they occurred in real time, often with editorialized “play-by-plays” from an announcer. Such innovation in event coverage introduced a social element when fans gathered in their homes around the family radio set to listen to events (Bittner and Bittner 1977). Later, technological innovation replaced the radio with television as the most popular media type for experiencing sporting events. Television combined the audio experience of radio, but now people could see what was happening on the screen (Bryant and Holt 2006). With that screen, fans could now see the action live, with replays and close-ups, without ever leaving their living rooms.

In much the same manner that radio and television revolutionized how we experience sporting events, the Internet changed it even further. With readily available information at their fingertips, sports fans could suddenly find information about their favorite teams and view clips of events involving that team on several digital media outlets (Bryant and Holt 2006). The advent of online streaming services like Hulu + Live TV™ (Hulu© n.d) and ESPN+™ (ESPN© n.d) further encouraged sports viewers to subscribe to their services partially for information about their favorite sports and sports teams. Professional sports organizations have developed their own platforms for sharing information such as the Major League Baseball (MLB) At Bat™ application (MLB© 2019) and the National Hockey League (NHL)® application (BAMTECH LLC 2019; Newman 2017). These streaming services not only imitate what television broadcasts do but are able to expand the functionality beyond traditional television by giving the user more information about their sports team at the press of a button (Hulu n.d; ESPN n.d; Newman 2017). While the age of streaming sports provides information access via monitors, televisions or mobile devices, streamed sports remains limited to 2D presentation. With the recent arrival of virtual reality (VR) technology, sports fans can now experience an even more-realistic, 3D viewing of events via head-mounted displays (HMDs).

While not currently in widespread use, HMD sports media coverage is expanding with companies such as NextVR© (NextVR, 2018). These companies use specialized, custom-created equipment (Brown 2019) to record sporting events typically in a format that combines 180-degree sports footage with another 180 degrees of computerized backdrops (NextVR, 2018). This creates a 360-degree experience that can be displayed on HMDs such as the Oculus Rift™ (Facebook Technologies 2016) and HTC Vive™ (HTC Corporation 2016) such as what NextVR produces (NextVR 2018). As they pursue the development of an immersive experience for users within sports entertainment, NextVR has partnered with sports leagues and broadcasters alike (e.g., Fox Sports, NBA, NHL) to provide an HMD viewing experience via their headset-mobile application (NBA n.d; NextVR 2018; NHL Public Relations 2019) allowing users to experience being close to the action in the headset, while remaining at home.

With sports media platforms evolving at such a rapid rate, user-experience research needs to catch up and examine not only whether there are differences between watching sports using different technologies, such as on a 2D television screen vs. an HMD, but also whether or not those differences are interpreted as good

or bad. A related issue is whether these sports experiences offered via new technology enhances user satisfaction and enjoyment. To address these empirical questions, the remainder of the chapter is organized to summarize previous research that resulted in the classification of sports media as a hedonic system that influences user arousal, analysis of user characteristics and then a consideration of viewing context. Using this approach, we later describe results from a pilot study that should inform our conclusions regarding the future of user-experience testing within the domain of technology-facilitated sports media viewing.

9.1 EXAMINING THE SPORTS MEDIA EXPERIENCE THROUGH USABILITY WITHIN A HEDONIC SYSTEM

Even though the sports media experience occurs within a highly specialized context, the foundation of user-experience and usability at its most basic level involves the interaction between a user and the technology. The user operates this technology to display the content that they want, which in this case is a sports game. The combination of previously examined general usability and user-experience theory with sports media viewing theories can provide more insight into these relationships between the user, the technology and the content that the technology is displaying, thus providing a base for more specific investigations of these highly specialized situations, as detailed in the next sections.

By its very nature, sports media viewing typically involves a hedonic entertainment source. This understanding is notable given differences between hedonic (pleasure-focused) and utilitarian (productivity-focused) user acceptance models where hedonic systems differ in the design and end goals from utilitarian-focused systems (Van der Heijden 2004). Designers of hedonic systems often prioritize the user's experiences of pleasure by making design decisions such as the addition of colored displays that encourage prolonged use, often the end goal. By contrast, utilitarian systems prioritize design decisions that minimize potential distractions to users and emphasize efficiency in leading the user towards their task goal. These systems are focused on the end goal of getting a user to complete a task in as efficient and timely a manner as possible. Thus, results from the assessment of more hedonic systems demonstrate that the behavioral intention to use such systems is strongly related to perceived enjoyment and perceived ease of use, whereas perceived enjoyment was less important to utilitarian systems (Van der Heijden 2004).

9.2 THEORIES OF AROUSAL AND AFFECT UNDERLYING USER-EXPERIENCES WITH HEDONIC SYSTEMS

Because hedonic systems are designed to elicit pleasure and enjoyment, an understanding of how emotional arousal is influenced by the choice of entertainment media is needed. According to the excitation transfer theory developed by Zillmann (2008), arousal is derived from the physiological activation of the sympathetic nervous system by exposure to stimuli from different sources that combine to intensify a user-experience. Within this theoretical framework, exposure to stimuli from one

source (e.g., a game viewed on the television) results in residual excitation that can be transferred to another source (e.g., switching the channel to another game). Thus, successive emotional changes might be intensified by previous exposures. Consider a sports viewer who switches channels from a hedonically negative event where she was disappointed in the poor performance of a favored team to another game where the competition is heightened. Residual excitation from the first game might intensify the subsequent euphoric experience of viewing a highly competitive match where the outcome is less certain. In effect, the user might experience intense enjoyment due to the suspenseful conclusion of the second game.

A related concept is that the enjoyment of sports entertainment is derived from affective disposition theory (Zillmann and Cantor 1976; Raney 2017) where users make judgments about their dispositions towards characters (i.e., players or teams). This affects the user's emotional reaction to the characters' actions and struggles, which then affects the user's enjoyment. If this theory (Zillmann and Cantor 1976; Raney 2017) is applied to a sports context, users should experience heightened enjoyment when "liked" individuals or teams experience positive outcomes, such as a win, or when "disliked" individuals or teams experience a negative outcome, such as a defeat. There is a sports-specific, theoretical application of this concept known as the disposition theory of sports spectatorship (see Zillmann, Bryant, and Sapolsky 1989; Peterson and Raney, 2008) where viewers develop affiliation to a particular sports team that can be from extremely positive to extremely negative on a continuum. That then impacts the viewer's experience and enjoyment of the content. In effect, sports spectator enjoyment is a byproduct of the emotional valence and outcome. As will be discussed below, this emotional valence might be further related to fanship, a user characteristic associated with enjoyment. Users high in fanship or fans in this case being users who display intense interest and emotional investment into certain activities, like watching sports (Cummins 2009).

9.3 TECHNOLOGY MANIPULATIONS TO ENHANCE AROUSAL

Although the primary emphasis of the current work will address how emerging technologies might enhance sports viewing, it is apparent that television continues to be a popular technology used to watch sports (Kim, Cheong, and Kim 2016; Peterson and Raney, 2008). Thus, it is no surprise that much of the controlled, laboratory-based research on sports media has focused on viewers' reactions to sports games displayed on television screens. These efforts included research such as studies by Gan, Tuggle, Mitrook, Coussement, and Zillmann (1997) and Peterson and Raney (2008) that have explored suspense and enjoyment as part of the sports user-experience with events on 2D screens. Some of these previous research used methods reminiscent of traditional usability and user-experience studies, most notably the works of Cummins (2009), and Cummins, Keene, and Nutting (2012).

In the first of two related studies, Cummins (2009) focused on the user-experiences of presence defined as a feeling of "being there," emotional arousal and enjoyment as experienced via subjective camera angles. He also examined how user characteristics, such as fanship, could impact that user-experience. This study was

a 2 (camera angle) \times 3 (sports fanship) \times 3 (viewing order) study with both within-subjects (camera angle) and between subjects (sports fanship and viewing order) variables. Subjective camera angle focused on the first-person view of the action from the athlete's perspective, such as focusing on what the driver sees while driving in NASCAR (Cummins 2009; Narducci 2007) while an objective camera angle described a more third-person, sideline perspective akin to traditional camera angles of football (Cummins 2009; Cummins, Keene, and Nutting, 2012). Participants viewed 16 plays that were split by camera angle into two separate groups, subjective camera and objective camera. The videos were paused in between plays so that measures of sports fanship, presence and enjoyment could be collected. The technology-focused results of this study indicated that the use of an overhead subjective camera enhanced both spatial presence and engagement for the users. Other results involving fanship and gender along with camera angle and presence variables will be described in Section 9.4.

In a follow-up study, Cummins, Keene, and Nutting (2012) re-visited many of the same variables by examining differences in presence, arousal and enjoyment by the camera angle. They also examined if clips with more excitement would lead to greater presence and arousal than clips with less excitement. Finally, they examined a potential interaction between camera angle and perceived excitement by assessing whether exciting clips played using subjective camera angles would demonstrate more arousal and excitement than clips played with objective angles. This study used a 2 (camera angle) \times 2 (potential for excitement of clip) \times 4 (viewing order) experimental design using 14 clips taken from a televised football game between Florida State University and the University of Miami. As with the previous study, stimuli video clips were classified into two groups based on their camera angle as either subjective or objective. Arousal was measured using skin conductance throughout the plays, with the participants completing additional self-report measures in between plays to assess presence and enjoyment. Results indicated that camera angle was related to the reported presence and skin conductance as a physiological measure of arousal. Clip excitement did elicit more subjective presence and arousal along with larger, although not more frequent, measured skin conductance arousal. An interaction effect revealed that less exciting clips presented with a subjective camera angle were self-rated as more arousing whereas more exciting clips presented with a subjective camera angle were self-rated as less arousing.

9.4 UNDERSTANDING THE IMPACT OF USER CHARACTERISTICS

Although technology-based manipulations can influence the enjoyment of sports media as demonstrated above, user characteristics such as gender must also be considered. Previous research indicates that gender can influence viewing preferences and motivations for fanship, as well as be a predictor for overall enjoyment of sports-watching experiences (Dietz-Uhler, Harrick, End, and Jacquemotte 2000; Gan et al. 1997; Peterson and Raney 2008; Sargent, Zillmann, and Weaver III 1998). With regard to spectating preferences, men appear to be fonder of confrontational types of sports such as ice hockey, football and basketball while women tend to gravitate

towards competitive but non-aggressive sports such as gymnastics, figure skating and diving (Sargent, Zillmann, and Weaver III 1998). Additionally, potential gender differences in motivations for being a sports fan were explored by Dietz-Uhler, Harrick, End, and Jacquemotte (2000). Men tended to be motivated by previous experience of playing sports and getting sports information while women tended to be motivated because they attend games and watch with family and friends. However, the results of other research that has considered gender as a possible predictor of enjoyment have been mixed (Gan et al. 1997; Peterson and Raney 2008).

Perhaps more promising than simple gender differences is recent literature on fandom that has examined differences between sports fans and non-fans (Cummins 2009; Cummins, Gong, and Kim 2016). A sports fan can be defined as someone with a strong emotional attachment towards sports (Gantz, Wang, Paul and Potter 2006; Cummins 2009). People who identify as sports fans have their own cognitive and experiential reactions to sports media (Cummins 2009; Cummins, Gong, and Kim 2016; Potter and Keene 2012). For example, viewing behavior can be different, even at the eye level, between fans and non-fans. Cummins, Gong, and Kim (2016) investigated how fandom and other user characteristics could impact attention to information graphics in televised sports using a 2 (sports clip excerpt) \times 4 (infographic type) \times 2 (fanship, sports statistics and fantasy sports knowledge) quasi-experimental design. Independent variables were fanship, sports statistics and fantasy sports knowledge, while the dependent variables were fixation frequency, gaze duration and observation frequency. Regarding the part of the study that dealt exclusively with fandom and selective attention, results partially supported that selective attention for sports information graphics was different between people who were high and low in sports fandom. There were significant group differences in gaze duration but not with fixation frequency. Along with cognitive reactions, user perceptions of media can be different for sports fans. As an example, sports fans tend to feel more presence and enjoyment while watching sports compared to non-fans, as shown by Cummins (2009). In the study mentioned earlier on subjective camera angles, Cummins (2009) found people higher in sports fandom overall enjoyed watching the sports clips more and experienced more spatial presence and engagement than non-sports fans.

9.5 VIEWING CONTEXT MATTERS

While technology manipulations such as camera angle and user characteristics such as gender and fandom are important considerations in sports media enjoyment, other research has demonstrated that the context of viewing is also important. For instance, watching a game in a usual at-home setting is much different from experiencing the game “in person” at a sports arena. Although home television experiences have been thoroughly investigated (Kim, Cheong, and Kim 2016; Lombard and Ditton 1997), relatively few studies have documented the viewing experiences outside the home. An examination of the literature revealed that these previous studies have ranged from more qualitative studies of viewer behavior in places such as sports bars (Eastman and Land 1997) to actually comparing differing viewing

experiences of watching a sports game in a theater setting versus at home (Kim, Cheong, and Kim 2016).

An early effort in exploring viewing context was published by Eastman and Land (1997) who described a naturalistic observation of sports-watching behavior outside the home setting in sports bars. Trained observers were sent to six sports bars on weekends and afternoons where the average period of observation was reported to be 2.3 hours. The written and audiotaped notes about behaviors and conversations in the bars during those times were supplemented with additional information from open-ended interviews with staff at the bars. From those observations, the researchers reported that there were several reasons to explain why people choose to watch sports outside their homes, including active community participation, conversational and other social opportunities, easier access to restricted sporting events and as a diversionary activity for non-fans while waiting to eat and/or drink. Importantly, results from this study indicated that different viewing contexts could elicit different experiences for users.

In another study, the role of viewing context was investigated by examining how the holistic experience of viewing sports media in a theater varies from the viewing experiences with individual components in a home (Kim, Cheong, and Kim 2016). They examined differences in presence, suspense and enjoyment in home viewing versus theater viewing of sports media events. The study focused on examining a series of relationships between presence, game attractiveness, suspense and enjoyment that predicted that presence components including realism, immersion and physiological response along with game attractiveness contribute to perceived suspense and enjoyment. A total of 240 participants were recruited and randomly assigned to watch one of two FIFA World Cup games either at home or at a theater before completing a questionnaire that assessed presence, game attractiveness, suspense and enjoyment of the experience within one day of watching the game.

Results indicated that the three measures of presence (i.e., realism, immersion and physiological response) along with suspense and enjoyment were significantly higher in the theater condition than in the home-viewing condition. They also found significant relationships between presence, game attractiveness, suspense and enjoyment, with the presence components (except physiological response) contributing to game attractiveness to the suspense which then contributed to enjoyment.

9.6 EXPANDING SPORTS MEDIA VIEWING BEYOND 2D: THE EMERGENCE OF VIRTUAL REALITY

As the summary of previous sports media findings suggests, much of the extant research has been limited to studying user-experience within a 2D, television context. Because technology continues to evolve at a rapid pace, this work needs to be updated and expanded as emerging technologies such as virtual reality systems begin to appear as an alternate means to present sports media. Not only do technological components like head tracking within virtual reality result in higher levels of user perceptions of presence (Cummings and Bailenson 2015) but the creation of an entire virtual scene around a viewer can easily mimic a context similar to a

sports arena or even a home setting. Therefore, if virtual reality is going to create a possibly more pleasurable experience, future research designs studying it and sports media should be informed by what we know of hedonic systems (Van Der Heijden 2004).

The hedonic framework from marketing literature states that a user's adoption of a product is driven by his/her own imaginal (fantasy, role project and escapism) and emotional (enjoyment, emotional involvement and arousal) responses (Hirschman 1983; Hirschman and Holbrook 1982; Lacher and Mizerski 1994; Holsapple and Wu 2007). Given this concept, Holsapple and Wu (2007) adapted the hedonic framework to create a new framework for examining virtual technologies that described emotional responses as consisting of both arousal and emotional involvement. Arousal occurs when outside stimulation leads to a heightened mental and emotional state whereas emotional involvement describes how emotionally involved a user is in the task that they are doing (Holsapple and Wu 2007). Interestingly, these same factors directly determine the quality of user-experience with sports media as described in excitation transfer theory (Zillmann 2008) and the disposition theory of sports spectatorship (Zillmann, Bryant, and Sapolsky, 1989).

Due to the potential for virtual reality technology to enhance sports-viewing experiences through presence and suspense via the arousal and emotional involvement mechanisms described above, the next section details the first step into this process, examining how the role of video format presentation could be different between HMD (360-degree) and 2D (monitor) presentations.

9.7 PILOT STUDY: SPORTS VIEWING IN HMD WITHIN A VIRTUAL ENVIRONMENT IS DIFFERENT FROM 2D

Expanding on previous research published by Kim, Cheong, and Kim (2016) that directly compared sports-viewing experience by context (theater vs. home), Wilson and Mayhorn (2019) explored the reported differences in presence, suspense and enjoyment across two new contexts: HMD (360-degree) video vs. 2D (monitor). As shown in Figure 9.1, this pilot study was also designed to extend Kim et al.'s (2016) observed relationships between presence, game attractiveness, suspense and enjoyment to inform the user-experience within the virtual reality context of HMD.

To examine these differences and potential relationships in Wilson and Mayhorn (2019), two hypotheses were developed, based on the Kim et al. (2016) hypotheses, which are summarized as (1) There will be significant, positive relationships between presence components and suspense, game attractiveness and suspense, and suspense and enjoyment and (2) that HMD (360-degree) would outperform 2D (monitor) conditions on presence, suspense and enjoyment.

The video used in this pilot study was a five-minute video clip of the North Carolina State University Wolfpack football team scoring a touchdown. This moment happened during the first quarter of the North Carolina State Wolfpack vs. Florida State Seminoles game on November 3rd, 2018. This video clip was displayed in either HMD (360-degree) if played on the Oculus Rift (Facebook Technologies, 2016) or a

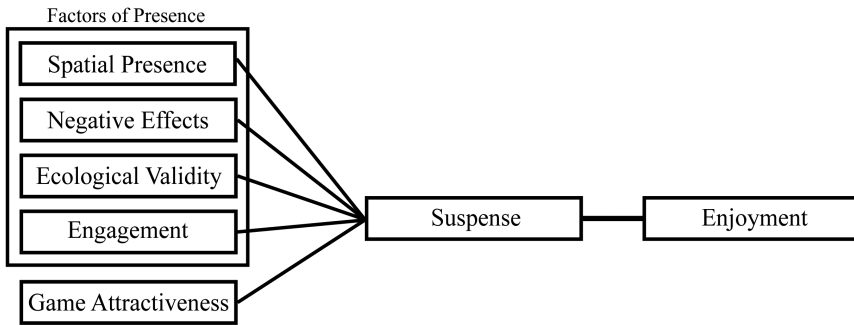


FIGURE 9.1. Proposed relationships between presence, game attractiveness, suspense and enjoyment (Based on relationships from Wilson and Mayhorn, “Examining the role of media in sports media viewing.” Santa Monica, CA: Human Factors and Ergonomics Society 2019).

monitor (2D) in the Movies or TV application on Microsoft Windows. Both versions of the videos were installed on an MSI gaming computer running Windows 10 OS (Wilson and Mayhorn 2019).

Beyond the preliminary sample described in Wilson and Mayhorn (2019), 83 participants provided informed consent and then completed a demographics survey adapted from Lessiter, Freeman, Keogh, and Davidoff (2001)’s ITC Sense of Presence Inventory. Afterward, they were randomly assigned to watch the video in either the HMD (360-degree) or the monitor (2D) condition. After the video, they completed the following surveys in counterbalanced order: an attention maintenance survey that queried participants about events in the video, an adapted version of the ITC Sense of Presence Inventory (Lessiter et al. 2001), game attractiveness items (Kim, Cheong, and Kim 2016) including a measure of team disposition adapted from Knobloch-Westerwick et al. (2009). Lastly, items intended to measure suspense in the media clip (Oliver and Bartsch, 2010) and enjoyment (Gan et al. 1997; Peterson and Raney 2008) were also administered in this set before the participant was debriefed and dismissed (Wilson and Mayhorn 2020).

Although the Kim et al. (2016) model was not a good match as indicated via confirmatory factor analysis, the proposed relationships were partially supported. In retrospect, this poor match is not very surprising given that it was derived from 2D environments such as theaters rather than HMDs within virtual environments. Most importantly, results revealed differences between the two video format conditions regarding presence, suspense and enjoyment. From the presence constructs measured in the ITC Sense of Presence Inventory (Lessiter et al. 2001), spatial presence and engagement were significantly heightened in the HMD (360-degree) condition compared to the 2D (monitor) condition. The same differences between the groups were also found for suspense and enjoyment, with participants in the HMD (360-degree) condition experiencing more suspense and enjoyment than those in the 2D (monitor) condition. In short, this pilot study demonstrates that even if the model previously described by Kim et al. (2016) was not a good fit to describe the users’ experience of sports media, measurable differences between users’ experiences of

presence, suspense and enjoyment between HMD (360-degree) and 2D (monitor) viewing of sports media were observed (Wilson & Mayhorn 2020).

9.8 CONCLUSION

Sports media has evolved from delayed announcements imported from overseas to a very limited audience to a quick, almost always accessible media that anyone anywhere can access at any point during the day (Bryant and Holt 2006). However, sports media research has tended to focus on the 2D presentation of content as illustrated in the work by Cummins (2009). While it is evident that sports media presentations in different viewing contexts result in measurably different user-experiences (Eastman and Land 1997; Kim, Cheong and Kim 2016), there has been little exploration of context as a technological variable. With the advent of virtual reality displays that use HMD, the need to explore how these new modes of sports media presentation influence user-experience as both a technology and a context is obvious. Interested companies such as NextVR (2018) driven by the commercial benefits of providing “next-generation” sports media viewing technology often implement their system designs without the benefit of peer-reviewed research findings. Likewise, the user-experience literature needs to further explore how virtual reality sports-viewing experiences address some of the known relationships between arousal, emotion, usability and enjoyment. These efforts might be further informed by how the properties of technologies (Van der Heijden 2004) as described in the hedonic framework (Holsapple and Wu 2007) have the potential to shape the user-experience of sports viewing.

The pilot study from Wilson and Mayhorn (2020) highlights an early attempt to explore differences in the user-experience of participants watching a sports game either in a traditional 2D technology or with the HMD of a VR system. The results from this study indicate that there are differences between the two conditions, although the relationships between the components of presence, game attractiveness, suspense and enjoyment did not follow previous literature (Kim, Cheong, and Kim 2016; Peterson and Raney 2008). The partial support for the hypothesized results may be due to several limitations present in the study such as a lack of a measure for fanship, which is important to perceptions of enjoyment of sports media (Cummins 2009). Also, the video clip that participants viewed was relatively short in length including five minutes before a touchdown was scored. The clip might not have been long enough and also the content itself might not have been considered suspenseful by the participants as one team was engaged in a “drive” to score and the other team was solely engaged in defensive action. Likewise, there is a variety of other factors that could be manipulated to enhance user perceptions of presence within the virtual environment. For instance, a current project in our laboratory is investigating whether the addition of multisensory feedback (i.e., haptic vibrations to mimic crowd noise) enhances arousal and enjoyment of collegiate sporting events. Given these potential limitations and future directions, we anticipate heightened research interest in this area to further explore what factors influence sports media viewing using HMDs within virtual environments.

One deliverable from this chapter is the realization that the combination of rigorous methodologies from both sports media and user-experience research can and should be implemented to explore this emergent topic. Moreover, it is our hope that other researchers and practitioners have gleaned an understanding from this manuscript that the evolution of sports media to include virtual reality (and future technologies) does not occur in a vacuum. Context and user characteristics matter. Because VR sports viewing represents a hedonic system, this research arena represents a unique contextual niche for usability professionals because the main focus is not on operational efficiency and productivity but emotional enjoyment and pleasure. As we have discussed, there is a wealth of literature that describes how user characteristics and technology interact with such outcome variables to influence the quality of the user-experience in very predictable directions that promote usability as well as technology adoption. Rather than haphazardly designing systems as the technology becomes available and perceived demand for services increases, this growing area of technology-mediated presentation represents a challenge and an opportunity for human factors professionals. Armed with empirical research findings from a variety of areas that address seemingly diverse topics such as emotional arousal, usability and technology design, human factors researchers and usability practitioners from allied disciplines such as computer science and industrial systems engineering can purposely collaborate to develop VR systems that provide both a usable and emotionally arousing sports-viewing experience to users. Game On!

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